

NOAA'S NATIONAL WEATHER SERVICE

STRATEGIC PLAN

2011 – 2020

Final Copy for NEP Review

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www.weather.gov/com/stratplan

Mission

Provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy

Vision

A Weather Ready Nation: Society is Prepared for and Responds to Weather-Dependent Events

Goals

- Improve weather decision services for events that threaten lives and livelihoods
- Deliver a broad suite of improved water forecasting services to support management of the Nation's water supply
- Enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks
- Improve sector-relevant information in support of economic productivity
- Enable integrated environmental forecast services supporting healthy communities and ecosystems
- Sustain a highly-skilled, professional workforce equipped with the training, tools, and infrastructure to meet our mission

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LETTER FROM THE ASSISTANT ADMINISTRATOR

Weather, water and climate affect each of us everyday – whether it’s a tornado or flood that threatens life and property, a severe weather outbreak which disrupts air traffic, or just a minor inconvenience due to hot and humid weather. The National Weather Service has the responsibility to provide weather, water and climate information to protect life and property and enhance the economy. We have met this responsibility for many years and, I hope you would agree, we have done it well.

However, population growth, vulnerable infrastructure, and an increasingly interdependent economy are creating new challenges for the Nation – including increased vulnerabilities to weather and climate. At the same time, science and technology are rapidly advancing and providing potential solutions that will enable the National Weather Service to better meet our country’s needs. This strategic plan is our effort to anticipate service needs in the 2020 time frame, project what science and technology will allow, and establish meaningful outcome-oriented goals and objectives for NWS 2020.

The Plan also provides a strategic framework that will guide our organization and investment over the next ten years. We are well aware of economic realities as we begin this period, but economic downturns are temporary while the need for our services is not. We hope this strategic plan will help us focus our resources on the country’s most pressing needs and prepare NWS to meet the opportunities and challenges of the future.

Our Strategic Plan is aligned with NOAA’s Next Generation Strategic Plan and is the result of a collaborative effort among our employees and the NWS Employees Organization (NWSEO), NOAA and NWS management, and our partners in the public, private and research sectors. The input received from all of these groups was closely reviewed and much of it has either been included in this plan or will be included in more detailed planning and implementation documents.

Our success in executing the Plan will depend critically on teamwork – within NWS and NOAA and with our partners in the public, private and academic communities. We will continue close collaboration with our NOAA colleagues as we develop more detailed strategies and implementation plans. Our success depends on all of NOAA’s capabilities. Collectively, we must be creative and innovative in our thinking, willing to embrace change and committed to achieving success that benefits all Americans – especially during challenging economic and budgetary times. We remain committed to open dialogue every time we propose specific changes in our products and services implied by the strategic plan. Following this path will enable NWS to become more capable, better equipped and more agile in providing service to our country -- providing more timely, high-quality weather, water and climate information for decision makers at all levels and contributing to safer, healthier, and more productive communities, ecosystems and economies.

Dr. John “Jack” L. Hayes

NOAA Assistant Administrator for Weather Services
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INTRODUCTION

The National Weather Service (NWS) has played a key role in protecting American lives and properties for over a century. The timely provision of reliable weather, water, climate, and environmental information has supported the Nation's social and economic development. NWS offices in communities across the United States and its territories, supported by regional and national centers, provide the authoritative information needed by Americans to plan, prepare, mitigate, and respond to natural and human-caused events.

The NWS is part of the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), an agency with a diverse mission to understand and anticipate changes in the climate, weather, oceans, and coasts; to share that knowledge and information with others, and to conserve and manage marine resources. The NWS contributes to NOAA's mission with expertise in weather, water, and climate prediction. NOAA's commitment to science, service, and stewardship informs society to respond and adapt to environmental conditions within a changing and uncertain world.

As the world has changed, so too has the NWS, advancing scientific and technical capabilities to better meet the needs of Americans. During the 1980s and 1990s, NWS deployed state-of-the-art observing and computing systems, improved modeling capabilities, re-aligned the organization to better deliver services, and made substantial investments in training and recruitment. The result was an organization with a greater capacity to provide timely information to save lives and avert disaster.

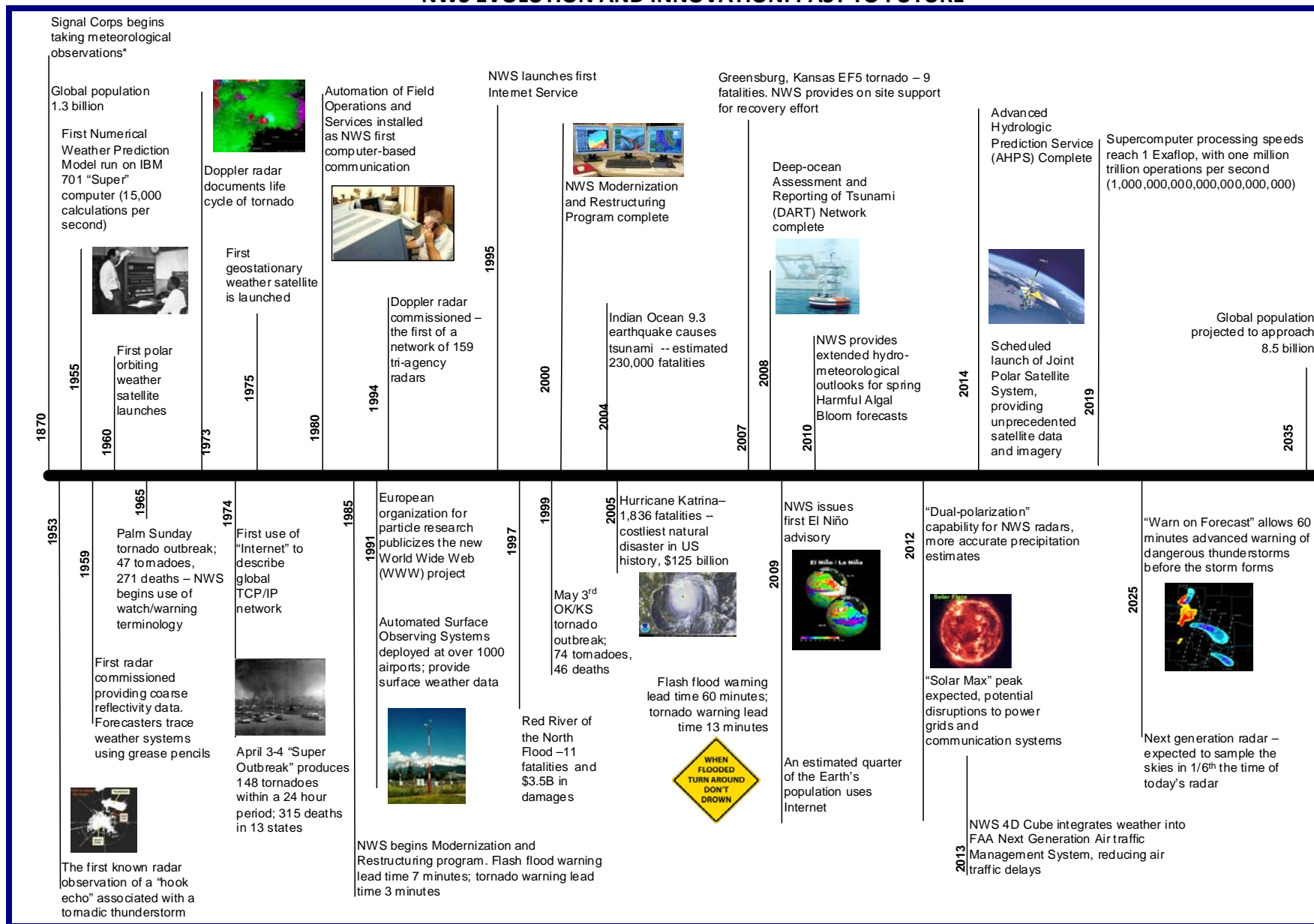
Today our science and services continue to evolve and improve to meet emerging needs. For example, NWS forecasters are working closer than ever with emergency responders to prepare for and avoid the impacts of natural and human-caused events. Space weather prediction and warnings are helping protect our Nation's infrastructure, and climate outlooks are contributing to the management of the Nation's water resources, energy supply and food security. Additionally, NWS data and information is becoming increasingly valuable as input into business and policy decisions. We are also responding to the changing ways people communicate, network, and share information, and we are using new technologies to make information more accessible and interoperable.

Over the next ten years, weather, water, climate, and environmental information will play a greater role in the significant decisions we make as individuals and as a society – from the quantity and quality of water we need and the quality of the air we breathe, to the generation and distribution of renewable energy, the safe passage of our country's highways, railways, seas, and airways – making everyday life safer, healthier, and more productive.

The timeline below encapsulates the evolution of NWS from its inception to the future, including the significant events and advancements that have shaped or will influence our services to the country.

In 1955, an F5 tornado devastated the town of Udall, Kansas, killing 68 percent of the town's residents. In 2007 an F5 tornado similar in makeup to the Udall tornado ripped through Greensburg, Kansas destroying the town. Emergency managers on the scene expected a death toll in the hundreds. Unlike Udall, Greensburg residents were prepared as a result of advances in the NWS warning system, radar improvements, and a strong partnership among NWS, emergency responders, media, and private sector. The number of fatalities in Greensburg was 9 - a casualty rate less than 7 percent of that in Udall 52 years earlier.

NWS EVOLUTION AND INNOVATION: PAST TO FUTURE



* Signal Corps was formed "... for taking meteorological observations... and for giving notice... of the approach and force of storms." In 1890 when the meteorological duties of the Corps were transferred to the Department of Agriculture, the "Weather Bureau" was officially named as an organization.

THE VISION

***NWS Vision** - A Weather Ready Nation: Society is Prepared for and Responds to Weather-Dependent Events*

New and evolving needs from society call for a shift in the way we forecast and warn to provide impact-based decision support services. This means we must place an increasing emphasis on weather-dependent events which significantly affect people, their livelihoods and the economy. We must go beyond producing accurate forecasts and timely warnings to better understanding and anticipating the likely human and economic impacts of such events. We must enable our users to better exploit NWS information to plan and take preventive actions so people remain safe, less damage is done to communities, businesses, and the environment, and economic productivity is maximized.

Impact-based decision support services, then, is the overarching paradigm from which the NWS will deliver weather, water, and climate-related services. This is not a new paradigm for the NWS – we have been supporting public safety officials since our creation – but our intent is to increase our focus on helping America make better decisions. This new focus has four elements: better understanding societal impacts, making our information more relevant to decisions, participating directly in decision-making for those decisions fundamental to the role of government, especially protection of life and property, and counting on market forces to provide diverse decision-support services across the entire economy. Specifically, it will require the NWS to:

- Understand the needs of our users and how weather, water, and climate data and information can be applied to create value and benefit. Operationally this means a focus on maintaining continuous situational awareness and interpreting information in the context of its impact on society
- Produce high-utility, decision-relevant data and information sensitive to societal, economic, and cultural criteria, communicated directly or through commercial partners in ways in which people fully understand and respond
- Deliver interpretive services, based on NWS forecaster expertise, to key decision partners for public safety and policy
- Implement information management, data discovery, and collaboration tools required to support this vision
- Foster the growth of America's weather and climate industries to provide diverse services to the entirety of US society and the economy

What is a High-Impact Event?

No standard, nationwide criteria define a high-impact event. It could last minutes or months. It may impact millions of people or one sector, and it may vary in timing or location.

It is any weather-dependent event that significantly impacts safety, health, the environment, economic productivity, or homeland security, such as:

- Persistent drought
- Thunderstorms in a congested air space
- Rains that trigger flooding and cause agricultural run-off, leading to harmful algal blooms and dead zones
- Geomagnetic storms that disrupt energy distribution and communication systems
- Snow squalls at rush hour
- An above-average hot day
- Coastal inundation
- Changes in Arctic climate

Scientific and technical advancements are essential enablers for providing impact-based decision support. Advanced information management approaches will create dynamic, integrated data available on-demand – the technical foundation of NWS operations and diverse applications outside of the NWS. The result will be a common, nationally-consistent, real-time weather picture, allowing NWS forecasters to better maintain situational awareness, focus on scientific interpretation, and monitor forecast challenges. The forecast team will be at the center of the information system producing and delivering information to enable human decisions. Linking social and physical sciences to produce and communicate information will be critical to our success. Integrated observations, Earth system models over a wider range of spatial and temporal scales, quantifiable forecast uncertainty, and advanced technologies will be enablers. These measures will extend the window America has to prepare for weather-dependent events that impact society.

Our workforce and partnerships are vital to the success of impact-based decision support. NWS will develop strategies and commit resources to enhance the capabilities of our entire workforce. We will add to the core skills of our scientists, meteorologists, and hydrologists to help them better understand and communicate the risks and impacts implied by our forecasts. We will focus on providing our engineers, technicians, managers, and administrators with the skills to be more effective problem solvers and collaborators. We want to recruit and partner with people from other disciplines: economists, behavioral scientists, ecologists, oceanographers, engineers, and health experts, among others. We want to better leverage the expertise and resources of our partners in the public and private sectors.

ACHIEVING OUR VISION

This section outlines the details of our strategic plan. It describes the long-term, mutually supportive goals, which contribute to outcomes for society. These are outcomes we cannot control alone but ones where our capabilities can have a positive impact on global decisions and the many challenges we face as a Nation. Examples of such outcomes are defined as measures of success for each goal. Below each goal, objectives and high-level strategies focus on service delivery and science and technology. Many of the strategies support the achievement of multiple goals.

SUMMARY OF NWS GOALS

- GOAL 1: Improve weather decision services for events that threaten lives and livelihoods
- GOAL 2: Deliver a broad suite of improved water forecasting services to support management of the Nation's water supply
- GOAL 3: Enhance climate services to help communities, businesses, and governments understand and adapt to climate-related risks
- GOAL 4: Improve sector-relevant information in support of economic productivity
- GOAL 5: Enable integrated environmental forecast services supporting healthy communities and ecosystems
- GOAL 6: Sustain a highly-skilled, professional workforce equipped with the training, tools, and infrastructure to meet our mission

GOAL 1: IMPROVE WEATHER DECISION SERVICES FOR EVENTS THAT THREATEN LIVES AND LIVELIHOODS

Urbanization and a growing population are increasingly putting society in harm's way of weather, water and climate events. For a growing number of people living in coastal communities, hurricanes, typhoons, and tsunamis threaten livelihoods and cause major damage to property and infrastructure. People who live along rivers and other inland waterways face increasing disruption because of more frequent and devastating flooding. Winter storms paralyze cities and regions for days and cost billions in cleanup and lost productivity. Tornadoes can take lives and destroy entire communities within a matter of seconds, while wildfires can burn for weeks threatening homes and natural habitats. Indirect impacts of these events, such as infrastructure failures, illness, and emotional trauma, can be just as significant. This goal seeks to minimize or even prevent such human and economic impacts.

Measures of Success: Improved community emergency preparedness leading to avoidance of fatalities from weather-dependent events; cost avoidance from unnecessary evacuations and property damage; more rapid post-event recovery

Objective: Provide demand-driven, impact-based weather services

Strategies for Achieving

The following are high-level strategies for achieving the objective. Details of how these strategies will be achieved will be described in the forthcoming NWS Services Roadmap. For additional information on the Services Roadmap, see the 'Implementation Section.'

- *User engagement:* Increase engagement with users and core partners to improve knowledge of user needs and better understand how users apply weather data and information to make decisions and manage risk. The NWS will also take steps to better understand the impacts of weather and weather information on society, economy, and homeland security
- *Decision-relevant Data & Information* - The knowledge gained from engaging users will allow the NWS to provide more specific, user-centric products and services that better enable decision making. For example, forecasts will compare weather risk to tolerance levels based on societal or economic impacts, communicating the potential social, economic, and environmental impacts. NWS warning criteria will be redefined to focus on a broader range of high-impact weather-dependent events targeting those at risk.
- *Interpretive Services:* Increase direct, interpretive services to public sector and emergency management officials for incidents of national, regional, or local significance. This will require a cadre of NWS professionals trained to respond to a variety of events and the tools to enable collaboration, communication and problem-solving with partners, users, and the NOAA workforce.
- *Outreach & Education:* Improve the preparedness and resiliency of those at-risk to the impacts of weather-dependent events through impact-based outreach and education. Continue to promote community preparedness programs, such as TsunamiReady™ and StormReady®
- *Partnerships:* Continue to engage and collaborate on global, national, and regional issues; and strengthen and broaden effective partnerships with other agencies, public and private sector partners, including America's weather and climate industry

Objective: Utilize emerging science and technology to improve weather prediction

The following are high-level strategies for achieving the objective. Details of how these strategies will be achieved will be described in the forthcoming NWS Science and Technology Roadmap. For additional information on the Science and Technology Roadmap, see the 'Implementation Section.'

- *Observations:* Integrate disparate observing systems by working with NOAA, public and private partners. NWS will also leverage non-NWS observing systems to fill observation gaps with a focus on the planetary boundary layer, urban areas, and the Arctic
- *Modeling & Prediction* – Improve data assimilation and high resolution models within an Earth system framework to address forecast challenges such as, thunderstorms, floods and flash floods, hurricanes and cyclones, with attention to urban zone and Arctic
- *Forecast Uncertainty:* Develop and implement an advanced capability to generate high-quality forecast uncertainty information through ensemble models and forecast system improvements
- *Forecaster Tools:* Develop and implement, with research community and other partners, forecaster tools that support data mining, enhanced visualization, smart decision assistance, and forecaster coordination and collaboration.
- *Data Access:* Extend access to weather, water, climate, and environmental data using national and international systems and standards, such as the 4D Cube
- *Decision Support Tools:* Develop and implement, with users and partners, tools to apply weather, water, and climate information, including forecast uncertainty, into user decision processes and systems
- *Social Science:* Integrate social science research, methods, and capabilities into science service areas, forecaster tools, and decision support systems
- *Partnerships:* Build and strengthen partnerships to find and influence emerging technologies and define requirements
- *Transition of Research:* Develop, in partnership with the research community, common modeling and operating infrastructures as well as testbeds to facilitate scientific and technological development and to accelerate the transition of research into operations

GOAL 2: DELIVER A BROAD SUITE OF IMPROVED WATER FORECASTING SERVICES TO SUPPORT MANAGEMENT OF THE NATION'S WATER SUPPLY

Whether too much, not enough, or of poor quality, water is a major national challenge. Water for homes, agriculture, energy, and industry is already in short supply. In 2007, Atlanta, Georgia, came within weeks of running out of water due to drought. That same year Lake Superior dropped to its lowest level in eighty-one years because of drought, warmer weather, and rising lake temperatures. The lower water level had serious economic and environmental consequences, including dried up wetlands, power plants running at half capacity, and cargo ships carrying partial loads. Water quality is a growing challenge for communities and ecosystems and is being affected by changing water temperatures and an increase in salinity, nutrients, and other pollutants. A growing population and more frequent, persistent drought and flooding brought on by a changing climate will only make the Nation's water management all the more challenging. This goal seeks to integrate and extend NWS water prediction capabilities to provide information and forecasts for a full suite of water forecast services. NWS will

collaborate with users and public and private partners to better enable water resource managers to make preventative, proactive decisions in a changing and uncertain environment.

Measures of Success: Less economic loss and property damage from flooding; more efficient management of municipal water supplies using integrated water forecasts and information; economic, ecological, agricultural benefits realized from forecasting water temperature, soil moisture and other parameters

Objective: Develop cross-government, integrated water resource services

Achieving this objective will require many of the service strategies from other goals, along with the following:

- *Water Resource Services:* By partnering with other federal water agencies, including the Environmental Protection Agency (EPA), expand services to provide forecasts for such parameters as water flow, temperature, quality, dissolved oxygen content, and soil moisture conditions for inland and coastal watersheds
- *Decision Support Tools:* Develop and deliver, with multiple government partners, including the U.S. Geological Survey (USGS) and the U.S. Army Corps of Engineers (USACE), decision support products and tools for water resource managers, focusing on weather and climate-related impacts for arid and coastal watersheds, based on interoperable high resolution summit-to-sea water resources data and information
- *Outreach & Education:* Expand education and outreach activities to better inform citizens, water resource and environmental managers of water demand, supply and quality issues.

Objective: Advance science and technology to improve and expand water forecasting

Achieving this objective will require many of the science and technology strategies from other goals, along with the following:

- *Observations:* Leverage our partners' observations to expand our collection of river, surface, and remote observations to fill critical weather and water observing gaps
- *Modeling & Prediction:* Develop higher resolution, coupled models for rivers, lakes, and estuaries based on a greater understanding of precipitation, temperature, evaporation and other hydrologic processes. The NWS will address challenges such as high and low flow, storm surge, and inundation supporting flood and flash flood prediction, while reducing hydrologic forecast uncertainty.
- *Partnerships:* Advance hydrologic services by leveraging science and technology across NOAA, other agencies including the USGS and the USACE, the private sector, and academia

GOAL 3: ENHANCE CLIMATE SERVICES TO HELP COMMUNITIES, BUSINESSES, AND GOVERNMENTS UNDERSTAND AND ADAPT TO CLIMATE-RELATED RISKS

In the recent past, changes in climate have created impacts that are vast, affecting all aspects of our ecosystems, society, and economy. These changes can be seen in an increased average global temperature, melting of sea ice, rising sea levels, and increasing ocean acidification. Seasonal

precipitation patterns have changed and weather-dependent events have increased in intensity and even frequency. Impacts can be both positive and negative, such as in the Arctic, where evidence of change is widespread and dramatic; the melting sea ice is already impacting natural habitats while providing opportunities for opening new sea routes for commerce and tourism. Other areas impacted by changes in climate include water resources, including municipal water supplies, global food security through impacts to agriculture yields, spawning success of fish and shellfish, and the location of seafood production facilities due to sea level rise. Future changes in climate will have impacts on many additional sectors, such as along our coastlines, where additional changes in sea level rise could have an impact on housing and development, transportation, commerce, and the economy. This goal supports the efforts of NOAA to deepen scientific understanding of climate, deliver climate services from global to local scales, and improve public knowledge of the impacts of a changing climate.

For decades NOAA and NWS have been providing climate information essential to many aspects of policy, planning, and decision making. Climate observations, monitoring, assessments of the state of the climate, modeling, and predictions—underpinned by the best available science – provide the foundation for today’s NWS climate services. In February 2010, the Department of Commerce announced the establishment of a Climate Service. The Climate Service and NWS will provide complementary services and work together closely to ensure comprehensive services across timescales from weeks to decades. The Climate Service will provide assessment services, climate projections, research to improve predictions and projections, and long-term adaptation services. The NWS focus will be on response and preparedness supported by the continued provision of climate prediction, monitoring, and assessment products and services, including applied research and modeling. The extensive nationwide NWS infrastructure will provide support to the Climate Service for delivery of NOAA climate services, and both organizations will leverage the NWS local community presence to help identify and address the climate-related needs of decision makers and planners. The NWS role in addressing these needs will be to help prepare communities for climate-induced weather and water events, while the Climate Service will help communities address longer-term adaptation challenges.

Measures of Success: Economic benefits in areas such as agriculture, water, and energy as a result of impact-based climate services; improved preparation and response to weather-dependent events based on climate forecasts; better management of environmental resources based on climate forecasts

Objective: Enhance NWS services to support development and delivery of NOAA climate services

Achieving this objective will require many of the strategies from other goals, along with the following:

- *Climate Forecasts:* Create a seamless suite of forecasts for week 2 and beyond to support response and preparedness to changes in climate that incorporate research advances from within NOAA and other partners
- *Decision-relevant Data & Information:* Engage users to better understand their climate information needs and deliver an expanded climate service portfolio that integrates social and economic factors into physical science-based products developed in collaboration with NOAA and other partners

- *Partnerships:* Strengthen local, state, regional, national, and international partnerships across various sectors; foster growth of an emerging climate service industry to serve diverse needs of America's economy

Objective: Improve and expand climate modeling for time scales from weeks and seasons to years

Achieving this objective will require many of the strategies from other goals, along with the following:

- *Observations:* Advance data assimilation techniques and leverage NWS, NOAA and partner observing systems
- *Modeling & Prediction:* Working with NOAA and partners, improve the capability to simulate and predict climate on multiple time scales within an Earth system framework, including the quantification of forecast uncertainty. NWS will also collaborate with partners to complete updates to the Nation's precipitation frequency estimates, incorporating the effects of climate change and developing techniques to update maximum precipitation estimates
- *Transition of Research:* Develop, in partnership with research community, common modeling and operating infrastructures and testbeds to facilitate scientific and technological development and to accelerate the transition of research into operations

GOAL 4: IMPROVE SECTOR-RELEVANT INFORMATION IN SUPPORT OF ECONOMIC PRODUCTIVITY

Avoiding economic loss and maximizing economic benefits from routine and high-impact weather-dependent events are critical to maintaining global competitiveness and homeland security. Today transportation is disrupted by storms, hurricanes, and flooding causing delays, loss of lives and cargo. Weather accounts for 70 percent of all air traffic delays, many of which are avoidable, costing billions of dollars to the economy. Many forms of renewable and alternative energy are weather and water-driven, requiring accurate, reliable forecasts to make critical production and management decisions. Extreme weather, like hurricanes, can disrupt oil and gas production and inaccurate forecasts can have huge economic impacts. Transmission of energy is vulnerable to extreme temperatures and geomagnetic storms. Unforecasted space weather activity can also interfere with communications and transportation systems causing disruption and major economic loss. In the agriculture sector, global food supplies are highly sensitive to weather, water, and climate, impacting everything from crop yields to the health of livestock. And for commercial and recreational fishermen, an accurate forecast of the day's weather has significant economic and safety implications.

Achieving this goal requires the collaboration and partnership of many government agencies and multiple sectors, honoring appropriate boundaries between NWS and America's weather and climate industry. The NWS views our role as developing better, more accessible data and information that enables America's weather and climate industry to better serve its clients as well as enables industry as a whole to better anticipate, plan, and make key decisions to increase economic productivity and protect lives and livelihoods.

Measures of Success: Economic benefits in weather-sensitive sectors of the economy, including transportation (air, land, and water), energy, and agriculture through efficiency gains, damage

avoidance, and increasingly valuable services provided by America's weather and climate industry

Objective: Strengthen use of weather-dependent information for informed decision making and risk management

Achieving this objective will require many of the service strategies from other goals, along with service delivery approaches for addressing the unique needs of weather-sensitive industries. The NWS will build a more inclusive process by which NWS and partners engage with users at local, regional and national levels to better understand evolving service needs and how NWS data and information services can be applied to improve decision making and manage risk. Targeted opportunities include the following:

- *Energy:* Engage the renewable energy sector, other agencies, and partners to expand observations, improve short-range to seasonal forecasts, and promote technical exchange and research. Identify opportunities to improve the utilization of weather, water, climate, and space weather information to improve the efficient transmission of energy.
- *Transportation:*
 - *Aviation:* Enable the FAA to make decisions based on a consistent environmental picture that creates a weather-safe national airspace, including volcanic ash and space weather needs
 - *Surface:* In collaboration with NOAA, America's weather and climate industry and surface transportation users, improve the integration, access and quality of weather, water, and climate data and information to improve the safety, mobility, and efficiency of roadways, marine, rail, and pipeline systems.
- *Agriculture:* Participate in national and international efforts to tackle global food supply and water resource challenges by contributing modeling and prediction capabilities

Objective: Improve forecast skill to accuracy and confidence levels required for decision making and risk management

Achieving this objective will require many of the science and technology strategies from other goals, particularly strategies to improve observations. Additionally, the NWS will focus on *modeling and prediction* strategies to:

- Extend temporal scales of weather, coastal, and ocean forecasts, from hours to weeks, with improved accuracy and quantification forecast uncertainty to support decision making and mitigate economic loss
- Improve space weather forecasting at global and regional scales for geomagnetic storms, solar flares, and other particles in an Earth system framework while improving data assimilation for application in energy, transportation, telecommunications, and other industries
- Improve prediction of thunderstorms, cloud coverage, and visibility to minimize impacts to the national airspace

GOAL 5: ENABLE INTEGRATED ENVIRONMENTAL FORECAST SERVICES SUPPORTING HEALTHY COMMUNITIES AND ECOSYSTEMS

High-impact, weather-dependent events, such as extreme temperatures, poor air quality, and the transmission of air and water-borne diseases, pose significant risks to the health of individuals and communities. As of 2008, approximately 127 million U.S. residents live in counties where air pollution exceeds national standards, causing decreases in lung function, more frequent asthma-related hospital visits and even premature death. Even daily management of chronic illnesses, such as diabetes and cardiovascular diseases, are affected by temperature, precipitation, and humidity. These elements also affect the timing and intensity of infectious disease outbreaks, and changes in climate may alter their geographic range and evolution. More frequent heavy rains and flooding can trigger sewage overflows, spilling raw sewage into drinking water supplies, lakes and waterways, and beaches. Other pollutants in our inland and coastal waterways cause harmful algal blooms, dead zones, human illnesses, and concerns about the safety of seafood harvests. This goal seeks to support NOAA and our partners by linking weather, water, and climate forecasts with biological, chemical, ecological, and other processes to reduce the impact of health and environmental hazards on our communities and ecosystems.

Measures of Success: Reduced incidence of health impacts attributable to air pollution and extreme temperatures; reduced incidence of water-borne illnesses due to improved water and beach quality forecasts

Objective: Extend weather, water, and climate forecasts to provide ecological and health-based information and services

Achieving this objective will require many of the service strategies from other goals, along with the following:

- *Interpretive Services:* Expand interpretive services in collaboration with our partners for persistent events, such as extreme heat or cold; seasonal flooding; drought and other changes in weather, water, and climate systems
- *Health-Based Forecasts:* Deliver, with NOAA and partners, information integrated to meet local and regional forecast needs, including: high resolution ozone, smoke, dust, and particulate matter forecasts; extreme temperatures; and the progression of insect and water-borne diseases
- *Ecological Forecasts:* Contribute, with NOAA and partners, the operational backbone for a defined suite of integrated inland, ocean and coastal ecological forecasts and services, based on NOAA priority forecast areas of beach quality, species progression, dead zones, harmful algal blooms, and disease pathogen progression
- *Partnerships:* Expand and build partnerships with local, regional, and national health, water and environmental managers to better understand and meet weather, water, and climate needs and explore new opportunities for collaboration

Objective: Harness evolving capabilities to enable ecological prediction

Achieving this objective will require many of the science and technology strategies from other goals, along with the following:

- *Observations:* Expand weather, climate, and air quality observations, particularly in high-impact areas, to support environmental surveillance relevant to, and in partnership with, public health agencies
- *Modeling & Prediction:* Expand air quality predictions for ozone, smoke, dust, and particulate matter, including research and development of airborne particulate matter, chemical data assimilation, and coupled meteorological and air quality predictions. The NWS will also collaborate with NOAA and other agencies to initiate development of an ecological forecasting system, coupling air, land, water with biological, geological, chemical, and ecosystem processes
- *Research to Operations:* Implement testbed framework to accelerate transition of ecosystem and health prototypes into operations and services

GOAL 6: SUSTAIN A HIGHLY-SKILLED, PROFESSIONAL WORKFORCE EQUIPPED WITH THE TRAINING, TOOLS, AND INFRASTRUCTURE TO MEET OUR MISSION

Whether issuing warnings, producing forecast products, engaging with users, managing programs, or supporting our operations, the people of the NWS are what make it a great organization. Our priority as we move towards impact-based decision support services is the sustainment and professional development of our workforce. This means strengthening the skills and capabilities that will allow our workforce to be successful in the future through training and recruitment. It also means investing in and developing future leadership talent, and continuing our commitment to diversity.

To be successful our workforce must be equipped with the necessary tools and infrastructure. We cannot meet the first five goals of this Plan without the investment in and sustainment of information technology and physical infrastructure.

Measures of Success: Future workforce skills and capabilities identified and aligned with training and recruitment; improved employee satisfaction; operational collaboration and knowledge-sharing tools for NWS workforce; increased high performance computing capacity; expanded and sustained facilities and infrastructure; expanded availability and interoperability of environmental data

Objective: Enhance knowledge and skills of our dedicated workforce

- *Training:*
 - Train workforce in climate science to make NWS a strong partner in the delivery of NOAA climate services
 - Enhance development and training programs to improve and expand leadership, management, and technical competencies of entire NWS workforce
 - Implement new and enhanced methods and technologies for training delivery, such as simulations and on-demand training integrated into applications and other systems
- *Diversity:* Continue to promote and expand policies, programs, and practices that lead to a diverse workforce at all levels of the organization
- *Recruiting:* Improve recruitment strategies to ensure future workforce skills align with NWS vision, including hiring university-trained hydrologists, space weather forecasters,

forecasters with exposure to disciplines relevant to evolving NWS needs, and modelers with the technical skills required for data assimilation and numerical modeling

- *Succession Planning:* Develop new strategies for addressing both short and long-term workforce and leadership requirements to meet emerging national and NWS needs

Objective: Provide state-of-the-science, reliable, secure, and extensible infrastructure

- *Information Technology & Communications:* Transform information technology and communication infrastructure to accommodate increasing data
- *Communication & Collaboration:* Use emerging technologies and other tools to improve communication, collaboration, and knowledge sharing internally and with our users and partners
- *Computing:* Expand and sustain state-of-the-science computing architectures and high-performance computing to achieve modeling and prediction improvements
- *Observing Systems:* Seek new approaches and opportunities to ensure the integration and sustainment of NWS operational observing and dissemination systems
- *Facilities:*
 - Expand opportunities to co-locate NWS facilities with key partners, as well as sustaining existing facilities through “green” improvements
 - Ensure NWS facilities portfolio is appropriately aligned to support a reliable and secure work and living environment
- *Equipment:* Develop the next generation forecast and decision support system, to include data mining tools, advanced visualization, and interoperability with partner systems

COLLABORATION AND PARTNERSHIP

As society grows more complex and scientific understanding of the environment grows more complete, the necessity for collaboration and partnership grows as well. To achieve our vision for 2020, NWS understands it must become one of the most adept institutions in the world at working with others. Our role is serving as weather, water, and climate experts, not becoming experts in other sectors or disciplines. For example, NWS does not seek to *become* a health care agency, merely help the health sector prepare for and adapt to the weather to make them more effective in the administration and delivery of medical care. Likewise, NWS respects the mission responsibilities of our federal agency partners while seeking ways to work with them to increase our collective effectiveness. Our strategic focus on collaboration and partnership encompasses increasing the capability of our workforce to team with others, empowering our offices to collaborate with other organizations, and an NWS institutional commitment to foster effective partnerships of many kinds. NWS seeks to improve collaboration and partnership with other organizations, with other sectors, and with other disciplines.

Emergency Managers and the Media – Key Partners for Public Safety. The dissemination, communication, and validation of NWS forecasts and warnings to the public depend on the media and the emergency management community. NWS will work closely with local, state, and national emergency managers to better understand the information they need to assess risk and make decisions. NWS envisions interoperable technologies that will make collaboration with emergency managers easier

and more seamless than today. The NWS will also continue our close relationship with the electronic media as they too evolve in response to new technologies and forms of communication.

America's weather and climate industry – Strategic Partners to Reach the Public and Impact the US Economy. NWS views America's weather and climate industry -- the diverse and growing companies, media outlets, and others that create weather programming, provide consulting services, and deliver information to American society -- as a key strategic partner that provides valuable services to many businesses while also being an important economic sector in its own right. With this plan the NWS hopes to contribute to the growth of this sector as well as benefit from new alliances and strengthened relationships. Working together we can extend and enhance critical services for the entire country.

Researchers and Academia – Critical to NWS Future. Achieving our science and technology objectives will not be possible without the close collaboration and contributions of NOAA's Office of Oceanic and Atmospheric Research (OAR), along with numerous other academic and research institutions that provide a greater understanding of the Earth's complex systems and help solve research challenges in the physical and social sciences.

Our sister Line Offices in NOAA – Interdependencies in both directions. The mission offices that comprise NOAA will continue to play a vital role in our day-to-day operations and the success of our future. Likewise, the NWS seeks to increase collaboration across NOAA Line Offices to collectively meet NOAA's long-term strategic goals and to deliver common services based on integrated environmental data and information. These offices are:

- *National Environmental Satellite, Data, and Information Service (NESDIS)* – acquires and manages Nation's environmental satellites, manages NOAA data centers, provides environmental data, and performs environmental assessments;
- *National Marine Fisheries Service (NMFS)* – conserves, protects and manages living marine resources within the United States;
- *National Ocean Service (NOS)* – protects coastal communities and monitors our coastal, Great Lakes, and deep-ocean waters;
- *Office of Oceanic and Atmospheric Research (OAR)* – provides the research foundation for understanding the complex systems that support our planet
- *Office of Marine and Aviation Operations (OMAO)* – manages and operates NOAA's ships and aircraft while managing data acquisition technologies
- *Proposed Climate Service* - In February 2010, the Department of Commerce announced the establishment of a Climate Service to provide assessment services, climate projections, research to improve predictions and projections, and long-term adaptation services

Federal, State, Local, and Tribal Government – NWS needs their help, and can do better at helping them. Looking beyond NOAA, we also rely on the expertise of other government agencies. The NWS vision of the future will require closer collaboration with tribal, local, state, and federal government agencies to provide more integrated, usable, and relevant information and services. NWS must strengthen relationships with many existing partners, while also developing new relationships that better enable integration of environmental information into emerging areas that have economic, environmental and health impacts. Examples of long-standing partnerships include DHS, FEMA, FAA, DOD, DOI, EPA, USDA, and NASA and numerous state, local, and tribal offices, and cooperative programs.

New Partnerships – An effective strategy for creating value. As NWS seeks to maximize its value to the taxpayers that support us, some of the most effective strategies can involve helping other organizations and agencies understand and better use the information NWS already produces. Similarly the NWS can make small changes in NWS products and services to increase their usefulness by better understanding the needs of new partners. This Plan identifies some of the sectors that underutilize our current and potential information.

International Partnerships – Weather is global, and so are we. NWS collaboration and partnership does not stop at US borders. We will continue to foster global collaboration working through the United Nations process and international agreements. Global cooperation on observations, data exchange, modeling, research and development is key to our continued and future success, as well as providing global leadership in setting meteorological standards and building partnerships to save lives and protect property.

Public and Educational Institutions – Part of our tradition and part of our future. Citizen volunteers, stretching back to Benjamin Franklin and Thomas Jefferson, have observed the weather, and in today's wireless world, produce on-the-scene observations that help NWS produce better warnings. In concert with the work performed by NOAA's Office of Education, NWS employees will continue to participate in the local community, whether volunteering at science fairs, hosting the Public at one of our local offices, speaking out about weather safety, or participating in school career days.

Multi-disciplinary teams – Key to future successes. Recruiting and sustaining a world-class NWS workforce will continue to be a priority. To increase value of NWS information, we seek to expand our skill set and work more closely with partners in other disciplines: economists, sociologists, communication specialists, and others schooled in the social sciences; information technology and information management experts; ecologists and biologists within NOAA and elsewhere; project managers, engineers; logisticians and equipment repair technicians; and specialists in other areas. NWS sees a future where success is almost always a team effort with many disciplines needed. The ability of the NWS workforce to recognize the need for expertise outside traditional areas and the ability of the NWS workforce to work effectively on multi-disciplinary teams is essential to the vision in this Plan.

IMPLEMENTATION

The success of our strategy relies not only in the Plan itself but in our ability to execute it. Our strategy must be integrated into everyday decision making, reflected in our resource investments, and supported by all of our employees. Management processes must be fine-tuned to support strategic action at all levels and encourage integration with budgeting and performance management. To guide the implementation of the plan, NWS is developing two supporting roadmaps for services and science and technology that describe in more detail how and when we will execute the objectives and strategies needed to achieve our vision and goals. The Services Roadmap, being developed by a NWS-wide team and managed by the NWS Office of Climate, Water, and Weather Services, will define NWS operational and human capital strategies needed over the next ten years. In keeping with NOAA's partnership policy, the NWS will continue to seek external comments on proposed new products and services supporting our vision for 2020. The Services Roadmap will be supported by the Science and Technology (S&T) Roadmap, being developed by a NWS-wide team and managed by the NWS Office of Science and Technology. The S&T Roadmap will enable enterprise solutions and allow for continuous improvements across the NWS science service areas.

The NWS plan derives from NOAA's Next Generation Strategic Plan, particularly the NOAA goal of a "Weather Ready Nation" (WRN). The NWS is a full participant in the NOAA strategic planning and budgeting process used to implement and evaluate progress against NOAA's Next Generation Strategic Plan and by extension the NWS Plan. NWS maintains a multi-year implementation plan for WRN including resource-constrained performance targets; helps NOAA evaluate progress toward NOAA's objectives for WRN and other NOAA goals; and formulates the NWS components of the NOAA budget.

The decision to adopt a ten-year time horizon for the NWS Plan in contrast to the five-year horizon for the NOAA Plan is purposeful. It allows the NWS Plan to provide additional details regarding the WRN objectives of the NOAA Plan, while at the same time establishing longer-range goals for changes NWS believes will require a decade to accomplish.

PERFORMANCE EVALUATION

NWS has a long-standing commitment to evaluate and report performance in objective and meaningful terms. The past approach to performance evaluation, embodied in the widely-reported Government Performance and Results Act metrics (e.g. tornado and flash flood lead time) augmented by periodic measures of customer satisfaction in key groups (e.g. emergency managers and water managers) will continue, and NWS will continue to seek ways to create more comprehensive and meaningful measures of its outputs – the products and services it provides.

However, the measures of success expressed in this Plan also signal NWS' intent to expand upon traditional performance evaluation. The measures of success express a desired societal outcome that depends not only on NWS outputs, but also on effective societal use of, and response to, these outputs. Performance evaluation based on outcomes is more challenging, but also more meaningful – it seeks to find out how and to what extent NWS products and services create value for society in terms of economic efficiency, economic output, improved public safety, etc. Progress in measuring such outcomes will significantly depend on utilizing work from economics and other social science disciplines outside NOAA. The NWS will use the measures of success as a starting point to define a detailed plan for how to define, baseline, and track more specific societal measures and targets.

APPENDIX A. GLOSSARY OF TERMS

Data – Observations, analyses, and forecasts representing weather, water, climate, and/or related conditions produced primarily through automated means, presented in numerically, and intended primarily to support further use; e.g., input to other analysis tools, decision tools, etc.

Information – Broader term that includes “data” as defined above plus the incorporation of human expertise, presented in numerical or non-numerical formats.

Decision-relevant – term used to describe NWS products and services that are useful and relevant to those who need to make decisions which are impacted by weather, water, and climate phenomena

Impact-based – term used to describe NWS products and services that communicate the likely societal, economic, or environmental impact of weather, water, and climate events

Sector-relevant – term used to describe NWS data and information intended to meet the needs of a user group in an economic sector

High-impact - any weather-dependent event that significantly impacts safety, health, the environment, economic productivity, or homeland security

Product – any packaging of NWS information

Service - a product delivered or activity that is carried out (advice, interpretation, etc.) that meets the needs of a user or that can be applied by a user

Data and Information Service – the integration, management, dissemination, and communication of weather, water, and climate data and information, whether pushed by NWS or pulled by the user, and including both the content and the means/method of delivery

Interpretive Service – the provision of weather, water, and climate expertise delivered in-person or virtually to key decision partners for the protection of life and property

Impact-based Decision Support Services – the overarching paradigm that reflects the NWS vision of the future which focuses on delivering decision-relevant data and information and interpretive services for high impact events

User - individuals, organizations, intermediaries, or other entities for whom products and services are provided by NWS

Partner - An individual, organization or entity that aids the NWS mission by providing complementary/additional weather, climate or water information to NWS or directly to users. In some cases, NWS Partners will operate under explicit terms and conditions that have been mutually agreed upon, but the general term also applies when NWS Partners pursue goals that aid the NWS mission independent of any explicit agreement.

Stakeholder - An individual, organization or entity who affects or can be affected by NWS actions

Note: user, partner, and stakeholder are not mutually exclusive terms; i.e. specific individuals, organizations, or entities may meet the definition of one, two, or all three terms.